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UMaine Today

University of Maine, Division of Marketing and Communications

Fueling Oceans R&D Economics At a Crossroads Going Viral

UMaine Today

CREATIVITY AND ACHIEVEMENT AT THE UNIVERSITY OF MAINE SUMMER 2011

9.11+10

A decade later, what has changed between 'them' and 'us'?

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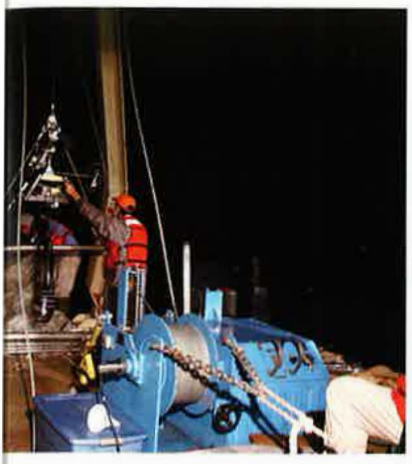

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President's Message

I HAVE ENJOYED using this space to share my thoughts during my seven years as UMaine's president. As I prepare to move on from this role, I would simply like to express my thanks.

In some way, virtually every *UMaine Today* reader has played a role in the university's substantial progress over the past several years. Whether you have been part of our community as an alumna, alumnus, student or parent, shared your talents as a faculty or staff member, cast a vote in favor of a university-related bond referendum, contributed to Campaign Maine, attended an athletics contest or artistic performance, or simply told another person about your positive UMaine experience, you have made a difference. I truly appreciate every person who has played a role in helping make UMaine the wonderful university that it is.

The greatest benefit of this job is the opportunity to meet the people — alumni, students, faculty and staff members, and friends — who exemplify the warm and welcoming nature of this magnificent university community. I will always treasure those relationships, and I will carry with me the memory of the innumerable stories that demonstrate so clearly the positive impact this institution has had on our state and on the individuals who have made the wise decision to join the University of Maine family.

With fondness and appreciation,

Robert A. Kennedy
President

ON THE COVER: Muslim fundamentalists often see the world in terms of a basic dichotomy between believer and infidel — them versus us. As the 10th anniversary of 9-11 draws near, UMaine fundamentalism expert and anthropologist Henry Munson provides perspective. See story on page 10.

Research hopes to aid wildebeest and other African species that are increasingly falling prey to shortsighted land-use decisions

By Jessica Bloch
Photos by Robert Lilieholm

IT'S ONE OF THE MOST impressive spectacles in the animal world, and one of a few of its kind remaining on Earth. Every year, millions of wildebeest migrate across the Serengeti-Mara ecosystem of southern Kenya and northern Tanzania, loping across the grassy plains, en route to dry-season lands and their calving grounds. Of course the approximately 500-mile journey is not without peril. Predators are a constant threat. Indeed, the wildebeest's migratory movements play a major role in the ecosystem's food chain.

However, through the last 40 years, something other than predation has hampered wildebeest migration, to the point that the animal's numbers have fallen 90 percent in some locales. In Kenya, human population growth in the capital city of Nairobi has sent development and urban sprawl spreading south, threatening to encircle Nairobi National Park. Increased development has meant more settlements and farms, more factories and quarries, new roads and more development along existing roads.

More development has also meant more fences.

And as fences proliferate across the arid savannas, more of the wildebeest's migration routes are cut off — a scenario Robert Lilieholm has seen firsthand during research trips to East Africa.

"At the local level, people are fencing for a lot of reasons, foremost to establish ownership but also to exclude wildlife. To many Kenyans, the animals are a nuisance, devouring their crops," says Lilieholm, a natural resource economist at the University of Maine who is part of a $680,000 National Science Foundation grant with Colorado State University researchers to look at fragmentation in this particular region of Africa. "It's sad to contemplate, but for a lot of rural Kenyans, it would be OK if Nairobi National Park just became a large fenced-in zoo. And that's what is going to happen without any active engagement and creative land-use planning."

The losses could be huge. Tourism generates nearly $900 million annually for Kenya's cash-strapped economy. Last year, tourists topped 1 million — a 15 percent increase from 2009.

Using mapping and a concept known as alternative futures modeling, Lilieholm's research in Kenya will show people at local and regional levels that the land-use decisions they make today could have far-reaching impacts in the future.

And while there are no wildebeest in the western hemisphere, Lilieholm is working to promote the same concept of alternative futures modeling in Maine in order transform the way state and

At a crossroa

In the last 40 years, human population growth has hampered wildebeest migration to the point that the animal's numbers have fallen 90 percent in some locales.

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The swelling human population requires more commercial and residential development. That's happening in Nairobi and along the Mombasa Road, the major north-south highway that links the capital to Mombasa, a key port city on Kenya's coast. In addition to new farms, plantations and dwellings, several cement plants have been built in the last five years just outside the boundary of Nairobi National Park.

At a crossroads

local interests think about future growth, development and zoning. Using modeling systems such as logistic regression and Bayesian Belief Networks, Lilieholm is showing communities that instead of taking a laissez-faire attitude to development, they can thoughtfully consider how to set aside areas for conservation, agriculture and forestry while maximizing the net contribution of important development initiatives.

"You have to recognize that whether you plan or not, you're going to change the landscape, oftentimes in irreversible ways," Lilieholm says. "Do you want to do it with more information or less? Do you want to anticipate the impacts of what you're doing or not? I would hope most people would say, 'Let's go forward with better information.' Without that, you can really undermine your future. You see it all the time."

For example, Lilieholm cites a 2006 Brookings Institution study that found that although Maine's school-age population was declining, the state's four largest metropolitan regions spent $186 million building new schools.

"Unplanned growth is expensive, creating the need for more infrastructure like roads, sewers and schools, while established systems are underused and in need of repair," Lilieholm says. "The result is costly, inefficient growth and high taxes."

A MEMBER OF the antelope family whose name is Dutch for "wild beast," the wildebeest probably isn't on anyone's list of top animals to see on an African safari — not when there are more glamorous and compelling species, such as cheetahs, giraffes and lions. The wildebeest — part of a group of mammals known as ungulates, which refers to hooved animals — is an odd-looking creature with its 90 degree-angled horns, shaggy beard, long face, unusual upper-body markings that appear to be skin folds, spindly legs, lumpy midsection, slender hindquarters and horselike tail.

Yet the wildebeest is remarkable, Lilieholm says, because it has the well-earned distinction of being one of the world's most iconic migratory species.

Lilieholm hopes to demonstrate to various stakeholders in Kenya the wide-reaching effects of their development decisions so they can better plan for the future.

With more than a million wildebeest migrating, they comprise a huge percentage of the animal biomass in countries such as Kenya. And because of their vast numbers, they play a crucial role in the food chain. Wildebeest are a favorite meal of crocodiles, as shown in a recent segment of "60 Minutes" on CBS about the migration.

In addition, the wildebeest is susceptible to landscape and climate change because its mass migrations are driven by the region's seasonal rains. Wildebeest herds tend to spend the dry season in places such as Nairobi National Park, which like many African national parks and reserves was set aside because it contains vital dry-season water sources.

Nairobi National Park is immediately south of Nairobi, one of the fastest-growing cities on the African continent. Nairobi has seen its population numbers explode in the last 40 years — from about 500,000 in 1970 to more than 3 million today.

The city has expanded to the north, Lilieholm says, and now population has spilled south, encircling the national park.

As in any expanding urban area, the swelling human population requires more commercial and residential development. That's happening in Nairobi and along the Mombasa Road, the major north-south highway linking the capital to Mombasa, a key port city on Kenya's coast. In addition to new farms, plantations and homes, several cement plants have been built in the last five years just outside of the boundary of Nairobi National Park.

However, it's not just buildings that are being erected. Residents of Nairobi's southern reaches are heavily fencing their property to establish boundaries and exclude wildlife. When the rainy season begins in March, the wildebeest herd in Nairobi National Park begins the migration east to its calving grounds. But with the growing patchwork of development

At a crossroads

and miles of fencing, the wildebeest have increasing trouble making the journey.

"The wildebeest are less able to meet their foraging needs and access water. And they can't get to their important calving grounds, and that's believed to be the reason there's been such a large decline in the population," Lilieholm says. "In addition, they are more susceptible to poaching and predators. Some also get caught and tangled in fences."

Fences and development have also affected the Maasai tribe, a politically powerful ethnic group in East Africa. Traditionally nomadic and pastoral, the Maasai too were used to migrating unencumbered through the landscape.

"When I was in Kenya in 2005, the location of the fences south of the park had been mapped and for the first time, people could view the extent of the fencing," he says. "The Maasai saw this and knew it had to stop, because it would be the death of their way of life."

Lilieholm and his Colorado State colleagues, including biologist Robin Reid, are also looking at development around the Maasai Mara National Reserve and Amboseli National Park, which have much larger wildebeest herds. Although urban sprawl is not a problem in those locations, which sit along Kenya's southern border with Tanzania, ecotourism is a huge issue.

Tourist lodges surrounded by 12– to 15–foot triple electric fences are springing up around the edges of the parks, forming a kind of pearl necklace around the land that chokes off animal movement. More ominous, Lilieholm says, is the recent appearance of such lodges inside the parks and reserves, including one at a spot considered an important rhinoceros breeding ground. How those lodges came to be built inside the park is unclear.

IN ORDER TO understand how wildebeest respond and migrate in the landscape — and to begin tackling the critical issue of how Kenyans can better plan for future development — the researchers need to know where the wildebeest are and where they're going.

Colorado State's Reid, along with Kenya-based colleagues Erustus Kanga and Jeff Worden, have radio collared 12–15 wildebeest in each of three herds in the Nairobi, Amboseli and the Maasai Mara parks to monitor the animals' hourly movements. Randall Boone, a UMaine graduate who is now at Colorado State, will use the hourly location data gathered from the animals to build agent-based models that can predict the behavior of individual animals. The models then will be scaled up to predict how herds behave across the landscape.

This is where Lilieholm's expertise comes in. His team, which includes UMaine professor of forest resources Steve Sader, is using satellite data from the 1980s forward to reconstruct development through time and forecast what will happen using logistic regression and Bayesian Belief Network models. The result will be a map of 1-hectare pixels showing the probability of future development.

Combined with assumptions about future population growth and settlement densities, a variety of future development "footprints" can be developed for the region. These future landscapes will then be merged with the agent-based wildebeest behavior model to explore how changing development and climate change scenarios interact to affect wildebeest migration.

"We can take that knowledge, overlay the agent-based models, and see how the animals are likely to respond to future landscapes they haven't encountered yet," Lilieholm says. "If we had done this 10 years ago, we would have been able to say, if the wildebeest can't get to a particular spot such as their calving grounds, and if they don't find substitute places, you're going to see a collapse in the population."

Lilieholm hopes to demonstrate to various stakeholders in Kenya the wide-reaching effects of their development decisions so they can better plan for the future.

Despite many and oftentimes competing interests — which range from national governments to tribes and the tourism industry — he believes the impact of showing someone a spatial depiction of his or her future can bring about a strong reaction, just as the Maasai reacted when they first saw how fences proliferated and restricted their livelihood.

"Without any active engagement, this area is going to become a large, fenced-in zoo," Lilieholm says. "Although the Maasai are just 12 percent of the population in Kenya, in this region they comprise a plurality and are politically strong — strong enough to have recently adopted a regional land-use plan that limits future development and fencing. Local conservation groups also are exploring ways to compensate people to remove

fences, especially fences that obstruct passage to the wildebeest calving grounds. Fortunately, there are some promising developments happening at different levels."

FOR LILIEHOLM, the wildebeest project is another vehicle through which he studies alternative futures modeling in the U.S. and abroad. He has been working in Africa for nearly two decades, beginning in Morocco and Uganda as a Utah State University researcher. In the 1990s, he was involved in a Ford Foundation- and World Bank-funded project to promote local sustainable harvests of wild forest-grown coffee as a way to generate revenue for communities surrounding Uganda's Kibale National Park.

"Biologists working in the park knew that the greatest threat to Kibale was from the surrounding communities, because they weren't benefitting from the park," Lilieholm says. "Although nationally there was a huge benefit through tourism and international aid, it wasn't getting down to the people on the ground, and that's where the coffee project came in. We were trying to find a way to get local people direct access to resources in a carefully monitored, controlled way, to build support and sustainability for the park."

Lilieholm also worked on bioregional planning with a Utah State group looking at alternative futures modeling in western areas of the U.S., such as earthquake and mudslide zones, and land management and development around military bases in California's Mojave Desert. Initially, some saw the approach as anti-development or overly concerned with environmental issues. But his colleagues, including landscape planning legend Carl Steinitz of Harvard University's Graduate School of Design, understood the value of using maps to help stakeholders visualize what's happening across the landscape.

"We can take that knowledge, overlay the agent-based models, and see how the animals are likely to respond to future landscapes they haven't encountered yet. If we had done this 10 years ago we would have been able to say, if the wildebeest can't get to a particular spot such as their calving grounds, and if they don't find substitute places, you're going to see a collapse in the population."

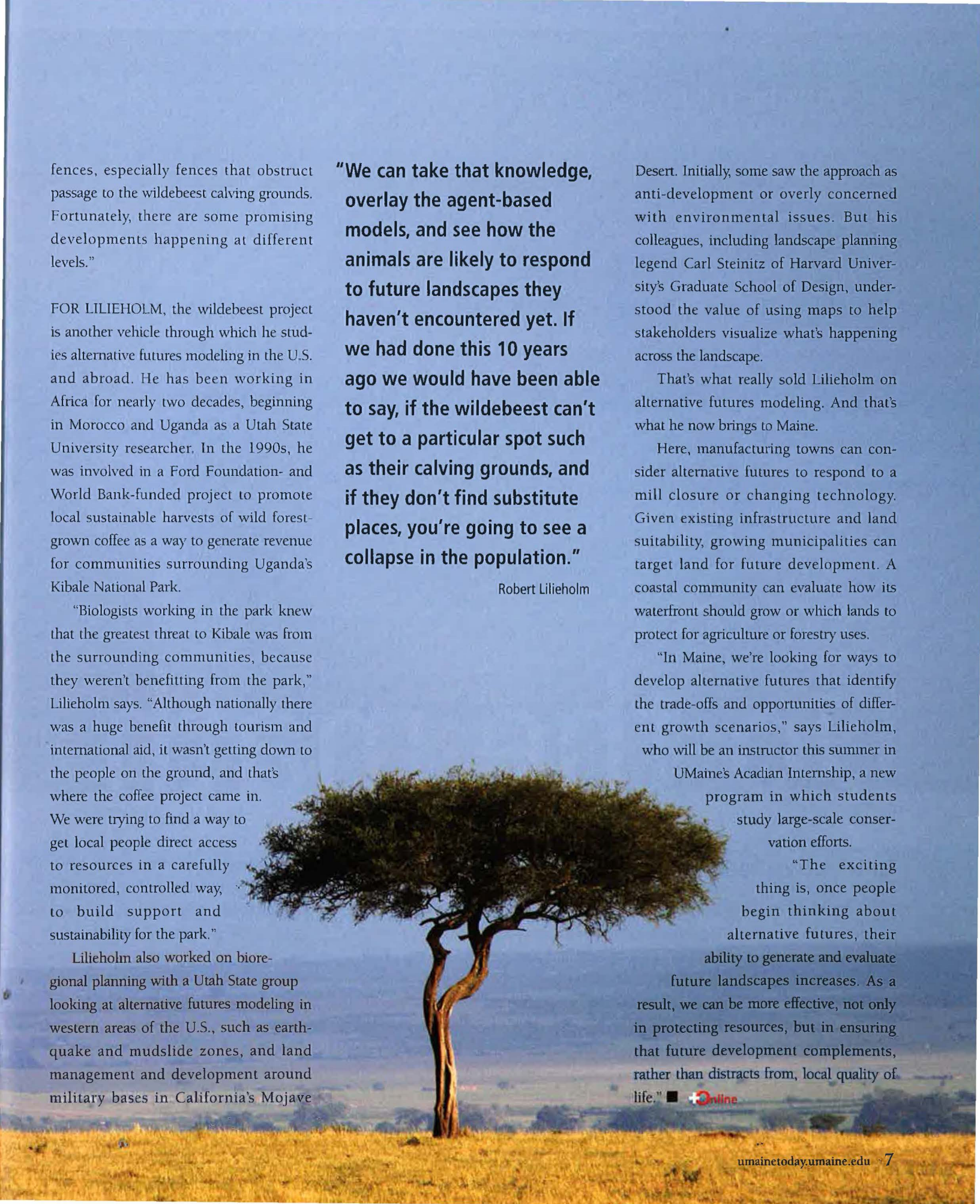
Robert Lilieholm

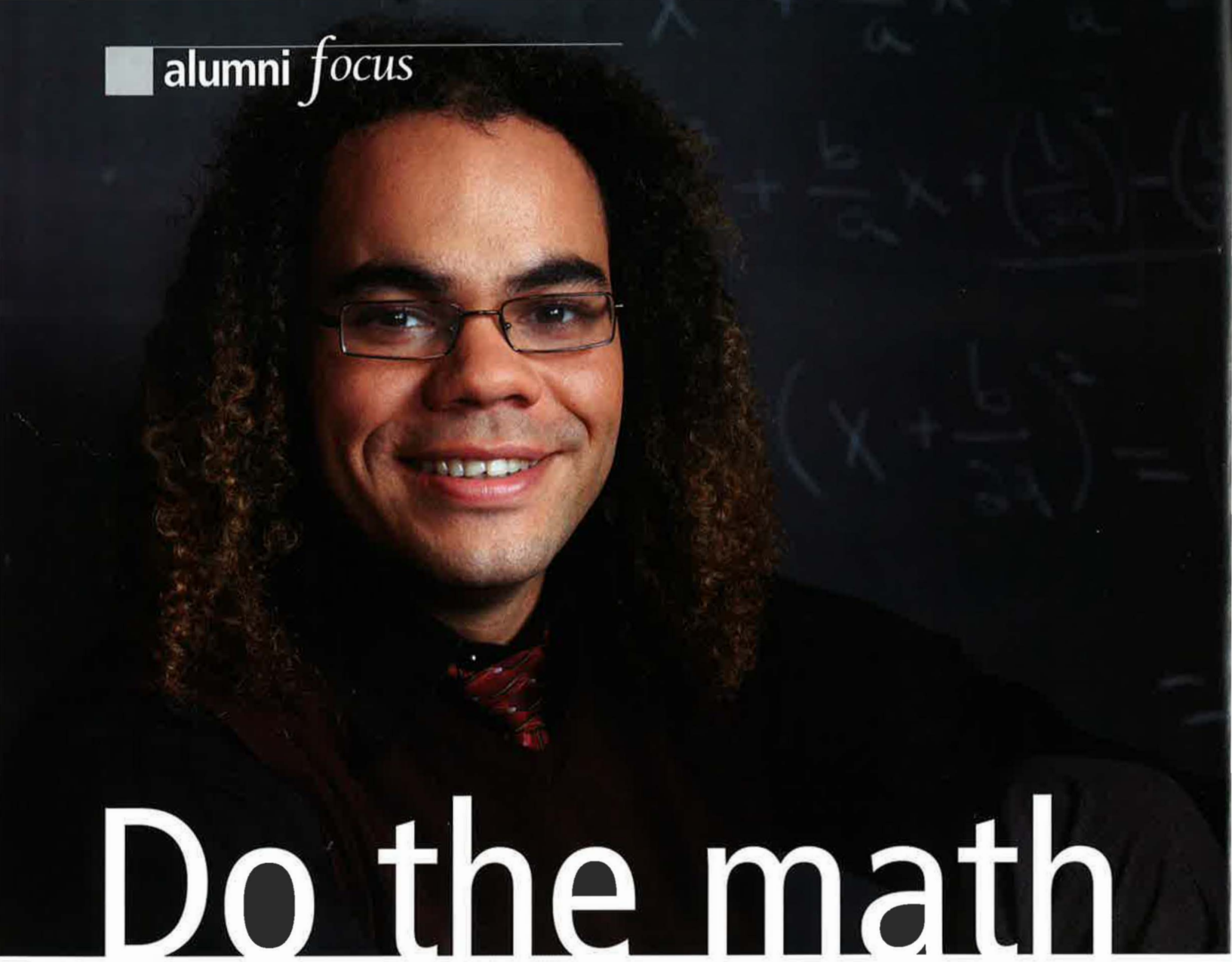
That's what really sold Lilieholm on alternative futures modeling. And that's what he now brings to Maine.

Here, manufacturing towns can consider alternative futures to respond to a mill closure or changing technology. Given existing infrastructure and land suitability, growing municipalities can target land for future development. A coastal community can evaluate how its waterfront should grow or which lands to protect for agriculture or forestry uses.

"In Maine, we're looking for ways to develop alternative futures that identify the trade-offs and opportunities of different growth scenarios," says Lilieholm, who will be an instructor this summer in UMaine's Acadian Internship, a new program in which students study large-scale conservation efforts.

"The exciting thing is, once people begin thinking about alternative futures, their ability to generate and evaluate future landscapes increases. As a result, we can be more effective, not only in protecting resources, but in ensuring that future development complements, rather than distracts from, local quality of life." ■ Online





Do the math

Photo by Michael Lisnet

Innovative teaching key to classroom success

Name: Chance Nalley **Hometown**: Perham, Maine **Graduation year**: 2004
Current position: Sixth- and seventh-grade mathematics teacher, Manhattan Middle School for Scientific Inquiry, New York City
Degrees: University of Maine, mathematics B.A. and secondary education B.S. Columbia University, M.A. and M.S. in mathematics education

What brought you to New York?

I am a minority and I grew up with only my father to relate to in regard to culture and acceptance, and what it is like to be different. Then, while studying at the University of Maine, I read a research paper that correlated student success with having at least one teacher/role model of the same ethnicity. Moving to a diverse city seemed like an opportunity for me to learn and help urban minority students.

The realization of this vision was made possible by Associate Dean O.J. Logue, who had a summer program, The Future Teachers Academy, which brought high school students from New York and Maine together at UMaine. He made arrangements for me to start at a school in the Bronx and everything played out well.

Tell us about the math skills curriculum you developed.

After a few years of teaching and adding two graduate degrees to my experience, I decided I was going to deal with what virtually every mathematics teacher already knows: There aren't any perfect mathematics textbooks, and as a sequential curriculum, everything in existence becomes even more devalued. We have a saying in the middle schools: "Seventh grade is sixth grade only louder, and the relation between eighth grade and seventh grade is no different." Each year, most students review previously learned topics with more difficult problems or deeper explorations. Only a handful of new topics are introduced each year.

I decided to view grades six through eight as a singular curriculum that started where fifth grade left off, and would logically and sequentially lead to rigorous courses in algebra and geometry. I reviewed the curricula and textbooks of over a dozen publishers, and many that were no longer in print, to create a scope and sequence that left nothing out. However, I'm not perfect and every year I make adjustments and add or modify the topics. The goal is to explore each topic in great depth, from the introduction through the mechanics, then the details and applications, to be sure that each student masters the skill.

The "mastery" idea really sets my work apart from that of others. I created individual student checklists to monitor that. Each week, students choose which topics they want to prove they have mastered and take quizzes focused on them. If a student scores 80 percent or better on the objective quiz, then the objective is checked off on his or her individual checklist, which is meant to follow him or her until every objective is mastered. Traditional curriculum ends in unit exams that cover many objectives; whether a student passes, fails or doesn't understand some objectives, he or she still moves on with the hope that he or she will learn it next year. Mathematics in the middle school is cumulative by nature. Not understanding an objective inhibits students' future ability to learn other objectives. I want my students to be fully prepared for algebra, geometry and any other course they take in the future.

What is the outcome? Do you feel like the students are better prepared?

The students know they are held accountable and that completing their objectives list is their mission. It fosters a different frame of mind than "this week's test" does. In the past three years, all my students significantly outscored city and state averages on standardized tests, even though we don't prepare for them directly. One hundred percent of my students were ready for algebra at the beginning of eighth grade and all passed the New York State Regents Exam in algebra at the end of the year for high school credit.

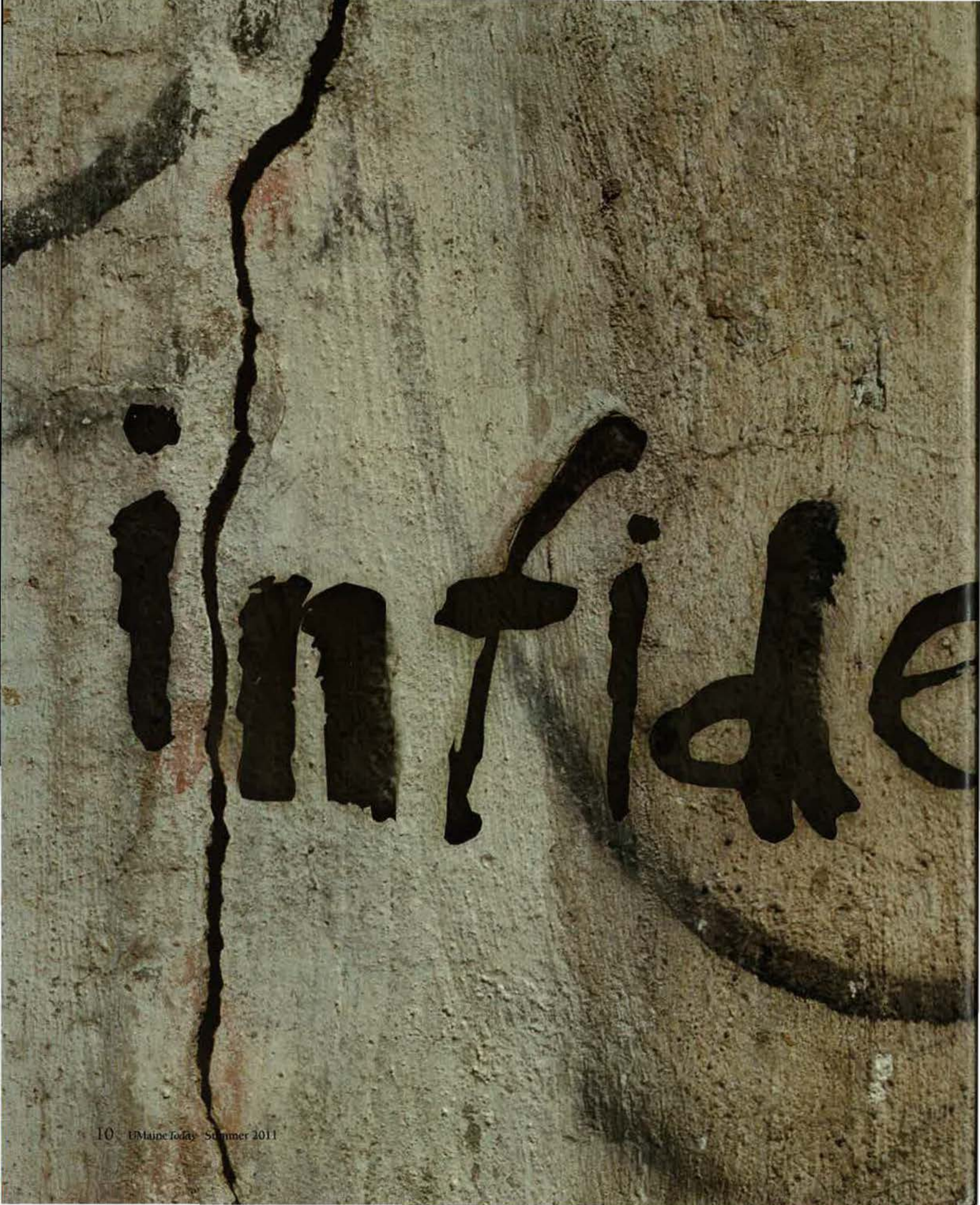
I moved to a new school last year and my students have all gone on to different high schools in the city. I hear back frequently from them or their parents, and always with the same comments: They are so well-prepared that they are bored. Some of my students have gone on to the top specialized high schools in NYC and others have gone on to private schools. Some have been placed in junior and senior mathematics classes to provide them with a rigorous learning experience.

Tell us about the honors and awards you received as a result of your work.

In 2008, I received the Manhattan Blackboard Award for Mathematics Teaching and also received a Math for America Master Teacher Fellowship. I am very proud to be part of Math for America, where I can work with other talented and dedicated mathematics educators and receive top-quality professional development. In 2010, I was recognized by Kappa Delta Pi as a Teacher of Honor.

How did UMaine prepare you for this career?

UMaine has caring and dedicated professors who make good role models for quality teaching. I was a lost soul that found direction and guidance at UMaine. When I work with student teachers from other schools, including Columbia University's Teachers College, they do not feel nearly as prepared as I did. People frequently ask me how I came to teach the way that I do, and I simply reply, "I'm from Maine."


inside

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A decade later, what has changed between 'them' and 'us'?

By Jessica Bloch

IN THE MONTHS AND YEARS following Sept. 11, 2001, the terrorist group that carried out the attacks on the United States was seen, at least by some Muslims, as somewhat heroic. That terrorist group, the Islamic fundamentalist collective known as al-Qaida, and its leader, Osama bin Laden, had reacted to what it and many other Muslims considered to be U.S. oppression and occupation in the Middle East. In striking the Pentagon and World Trade Center, al-Qaida hit directly at the heart of the enemy Americans in their government and financial centers.

Bin Laden, whom U.S. forces killed in early May of this year, was a Muslim fundamentalist who saw the world in terms of a basic dichotomy between believer and infidel. In his rhetoric, he stressed what he saw as the oppression of the Muslim world by the unbelievers of the West.

"Osama bin Laden succeeded in articulating widespread grievances, so for a while at least there was a certain perception of bin Laden as a hero, standing up to the imperialists," says University of Maine anthropologist Henry Munson, who has since the early 1980s studied fundamentalism and religion as they relate to violence, politics and nationalism. "You had that perception even among some Arabs who would have been horrified at the thought actually of living under a government led by bin Laden."

A decade after the day bin Laden-directed zealots hijacked three airplanes, felled the World Trade Center, and killed thousands in the worst-ever terrorist attack on U.S. soil, Islamic fundamentalism is still thriving in the Middle East in the form of groups such as Hamas, Hezbollah, and the Muslim Brotherhood. Munson stresses that each is very different, with very different agendas, although they all endorse states based on Islamic law. It's difficult to predict the roles they will play, especially as we look at the region through the lens of recent pro-democracy movements and as the fallout from bin Laden's death continues to be assessed.

"The Islamic movements often articulate resentment of foreign domination in terms of a basic dichotomy of us versus them, or believer versus infidel, but it is a mistake to ignore the nationalistic and social grievances these groups exploit," Munson says. "Trying to weaken these movements by military means is often counterproductive in that it increases the very resentment of foreign domination — and occupation — that drives some Muslims to support such groups."

PRIOR TO THE FIRST Gulf War, in which the U.S. became involved in order to force Saddam Hussein's Iraqi troops out of Kuwait, Munson says Osama bin Laden had worked on the same side as the U.S. against the Soviet occupation of Afghanistan. But bin Laden turned against the U.S. and Saudi Arabia when hundreds of thousands of American troops were allowed to be based on Saudi soil in order to drive Iraqi troops out of Kuwait, which Hussein had invaded in August 1990.

"The Islamic movements often articulate resentment of foreign domination in terms of a basic dichotomy of us versus them, or believer versus infidel, but it is a mistake to ignore the nationalistic and social grievances these groups exploit." Henry Munson

In 1996, bin Laden told journalist Robert Fisk that Saudi Arabia had "become an American colony." Munson stresses that although Islamic fundamentalists condemn nationalism in principle, they often articulate nationalist grievances.

"Bin Laden repeatedly said 9-11 was a response to American policies, that as long as Muslims are suffering under Israeli control in Palestine, the U.S. will have no security, and that the U.S. had occupied Saudi Arabia during the first Gulf War," Munson says. "He (saw) himself as a Muslim anti-imperialist fighting the infidels who seek to dominate the Islamic world."

Under President George W. Bush, the U.S. led a coalition that invaded Iraq and overthrew the regime of Saddam Hussein in 2003. The exercise in so-called regime change reflected, among other things, a failure to understand how fundamentalist movements like al-Qaida exploit resentment of Western domination, Munson says.

Although he agrees that it was necessary to destroy al-Qaida's training camps in Afghanistan, Munson argues that occupying Iraq simply served to reinforce bin Laden's message that the U.S. was trying to dominate the Islamic world. Iraqi Kurds and Shiites welcomed the overthrow of Saddam Hussein, but roughly 85 percent of the world's Muslims are Sunnis. And the Sunnis

generally saw the 2003 invasion of Iraq as just another case of the infidel West subjugating a Muslim land.

The Bush administration justified the U.S. decision to invade Iraq on the grounds that the country was somehow connected to 9-11 and was hiding so-called weapons of mass destruction. In fact, Munson says, bin Laden and Hussein — who was executed in 2006 following a conviction by an Iraqi court — could not have been further apart.

"The two had condemned each other, and Saddam had cracked down on the fundamentalists in his country," says Munson. "Bin Laden, in return, referred to Saddam as an American puppet, a socialist and a non-Muslim. So there was no alliance between the two, despite their shared hostility toward the U.S., Israel and Iran. And now, of course, we know there were no weapons of mass destruction. Saddam Hussein was an odious despot, but he was not a threat to the U.S."

Munson argues that many knowledgeable American intelligence analysts warned that the evidence presented by the Bush administration was often based on unverified assertions by Iraqis who were opposed to Saddam Hussein. Their warnings were ignored.

"In the case of Iraq, we had been stung by a wasp and decided to punch a hornet's nest," he says. "The decision to invade Iraq was made without looking at its internal political dynamics. Saddam Hussein was an easy person to target and some people had been advocating going after him for some time. But a sensible foreign policy is based on careful calculation of likely costs and benefits."

Ultimately, the decision to invade Iraq in 2003 was based on rash decision-making, Munson says. The emotional impact of the events of 9-11 short-circuited some of the rational analysis that should go into decisions about whether to go to war. And Iran has benefited from Saddam Hussein's overthrow far more than has the U.S.

The current prime minister of Iraq, Nouri al-Maliki, is a longtime member of a group called Al-Da'wa, according to Munson. Al-Da'wa was the first group to use suicide bombing against Saddam Hussein's government in the 1980s. The group also has close ties to Hezbollah and Iran. In fact, Hezbollah was initially widely seen as a Lebanese branch of Al Da'wa, Munson says, and many of its leaders spent years in exile in Iran.

"If we look at the government that exists in Iraq, it is dominated by Shiite fundamentalists with close ties to Iran. Yet this is a government created thanks to the loss of more than 4,440 American lives, and the expenditure of billions of American dollars," he says.

Anthropologist Henry Munson argues that occupying Iraq simply served to reinforce Osama bin Laden's message that the U.S. was trying to dominate the Islamic world.

THE SO-CALLED "Arab Spring" of 2011 had little to do with Islamic fundamentalism, and more to do with demands for democracy and economic opportunity. The widespread protests were initially sparked by the self-immolation of a vegetable vendor in Tunisia Dec. 17, 2010, to protest his treatment by local officials. From Tunisia, the protests spread to Bahrain, Egypt, Libya, Syria and Yemen. There have also been protests in Algeria, Jordan, Morocco and even Iraq, where the residents of Baghdad still only have electricity a few hours a day (which makes coping with summer temperatures that reach 120 degrees Fahrenheit rather difficult).

As of mid-April 2011, protesters had

only succeeded in overthrowing the governments of Egypt and Tunisia. What will rise in place of those governments is, for now, uncertain. Egypt could provide an interesting case study of fundamentalism's future in the Middle East, says Munson, who lived in Egypt during the mid-1970s while pursuing a certificate in literary Arabic at the American University in Cairo.

> "In the case of Iraq, we had been stung by a wasp and decided to punch a hornet's nest. The decision to invade Iraq was made without looking at its internal political dynamics." Henry Munson

Egypt is the most important Arab nation, he says, considering the strength of its military and its 1979 peace treaty with Israel, which has the strongest ties to the U.S. of any nation in the Middle East. The recent successful protests in Egypt were sparked by people involved in pro-democracy movements, whose demands included free elections and the removal of President Husni Mubarak.

Egypt's Muslim Brotherhood was initially not involved in the demonstrations in Tahrir Square — the flash point of the protests — until the group realized the protests had widespread support.

The Muslim Brotherhood has existed for decades, but has not resorted to violence since the 1940s, according to Munson. For that reason, more militant fundamentalist groups consider it too docile.

The brotherhood put forward a draft political platform in 2007, which it hoped would be seen as reformist and moderate, but which sought to prevent women and non-Muslims from serving in high government positions. Many Egyptians, including the roughly 10 percent of the population that is Christian, were outraged by the platform and remain determined to prevent the group from taking advantage of the overthrow of Husni Mubarak.

Munson notes that no matter how much one may disapprove of the rhetoric and agendas of groups such as the Muslim Brotherhood, one should not confuse them with more militant groups, such as al-Qaida. The Muslim Brotherhood and other fundamentalist groups do see opportunities for themselves in Egypt and other nations in the new Middle East.

"Some of these groups are licking their chops," Munson says. "However, the fact that they're licking their chops doesn't necessarily mean they're going to get to exploit the current turmoil to gain power. The key activists in Tahrir Square were clearly not Muslim Brotherhood people."

Munson does not think the death of bin Laden changes the basic political situation in the Middle East. He notes that the number of Muslims expressing support for bin Laden has dropped dramatically in recent years. According to the Pew Research Center, for example, 56 percent of Jordanians had "expressed confidence in" bin Laden in 2003. By April 2011, only 13 percent did so.

"The hope of many Muslims is that the democratic activists who talk about creating more humane and egalitarian societies will remain in the vanguard of these movements, and that when elections take place, they will be won by such people rather than by the Muslim Brotherhood," Munson says. ■ +Online

Sweet success

Rural Maine chocolate shop an inspiration

Assorted truffles, one of the 90 varieties of handmade candies sold by Monica's Chocolates of Lubec, Maine.

IT WAS THE FIRST SESSION in the three-part University of Maine Cooperative Extension workshop for people interested in starting their own businesses, and participants were encouraged to bring samples of the products they hoped to sell. Among them were handmade, gourmet chocolate bonbons individually wrapped in cellophane the colors of Mardi Gras. The confections made from an old family recipe were a sensation as much for their presentation as their taste.

Their creator, Monica Elliott, watched people's reactions, then turned to the interpreter accompanying her for a translation in Spanish. After three years of perfecting the recipe, the Peru native now living in Lubec, Maine, was launching her own business and this feedback was market research.

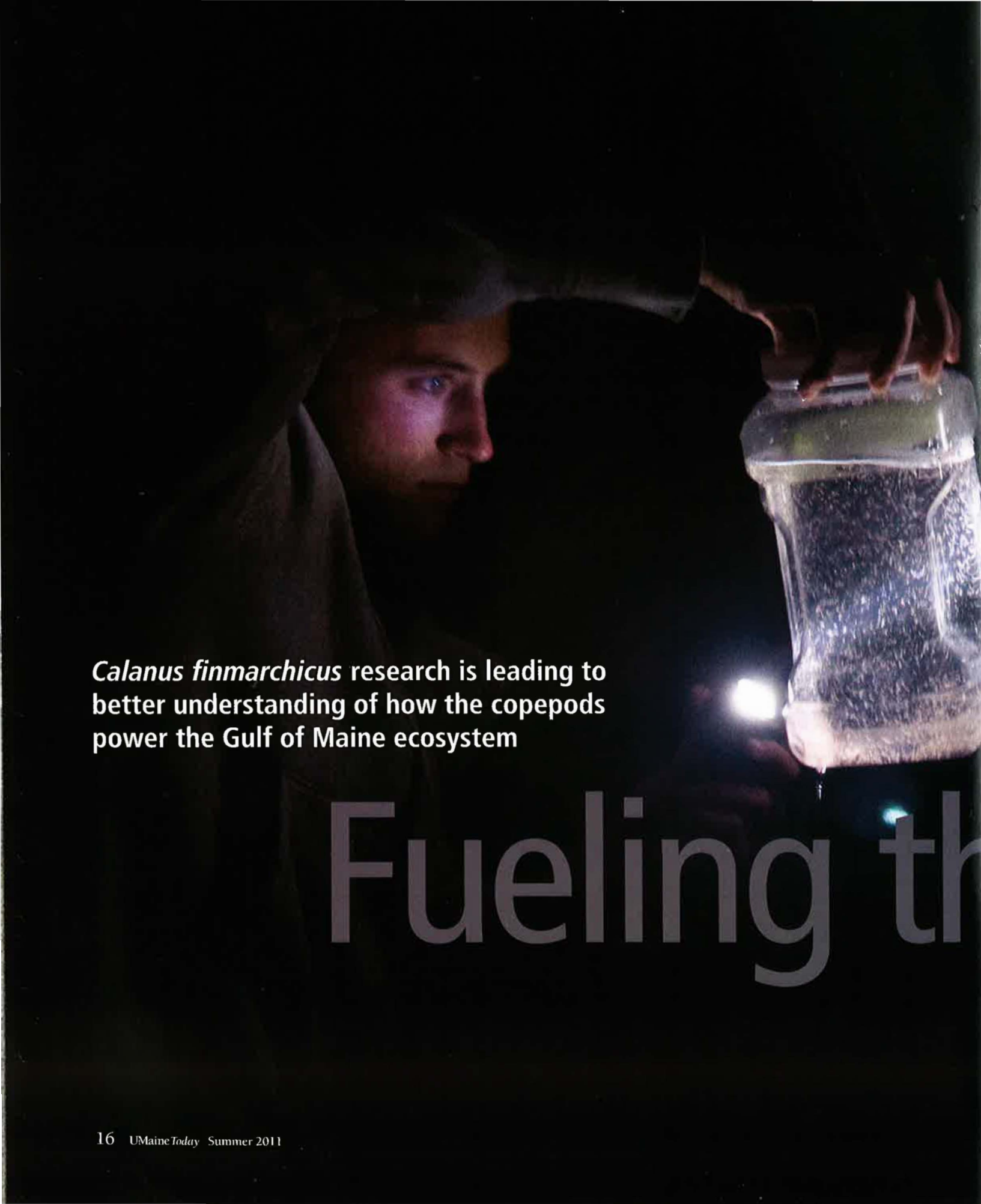
"You could tell from the beginning that she had a knack for business," says Regional Small Business Educator Louis Bassano, who led the workshop with Extension Specialist and UMaine Professor of Economics Jim McConnon. "This was a professional product she had developed and people loved it. And she was 100 percent committed to making it a reality."

In the 10 years she has been in Maine, Elliott has turned tragedy into triumph. She and her husband, Stanley, had moved from Lima, Peru, to Lubec, where he had just started working as a fisheries consultant when a brain aneurysm left him in a coma and nearly took his life. Elliott, who had spent 30 years building a successful fashion design business in Peru, found herself in a Down East Maine community where she didn't know the people or the language. So she took adult-ed classes in English. And she sought out advice from experts, including Cooperative Extension specialists Bassano and McConnon, who offer small-business workshops and one-on-one consultations.

Monica's Chocolates opened in downtown Lubec in 2005 with the help of $26,000 in loans from townspeople and one of the Elliotts' two daughters — all of which she paid back within a year. Four years later, it was clear that Monica's Chocolates had to expand to keep up with online and on-site sales. To do that, she needed a bank loan. And for that, she needed a detailed business plan. Bassano and McConnon helped her write one, complete with data on one of her strongest customer bases — bus tours headed to Campobello Island and West Quoddy Head Lighthouse.

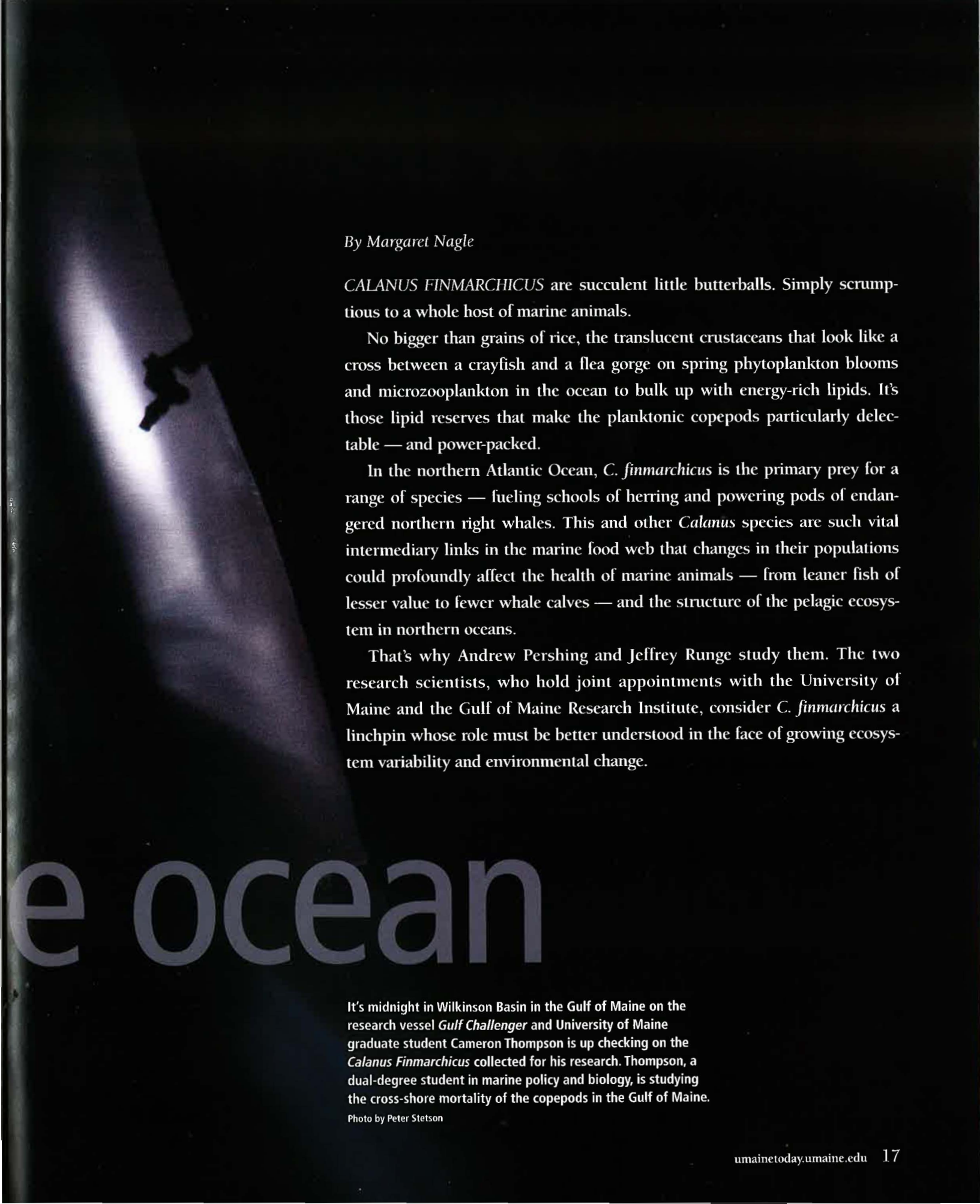
Today, Monica's Chocolates offers 90 varieties of fine chocolates and employs 11. Last year, Elliott received the Business Leadership in Action Award from Washington County Cooperative Extension.

"Monica is a shining example of what small rural communities can do to enhance their economic future," Bassano says.



***Calanus finmarchicus* research is leading to better understanding of how the copepods power the Gulf of Maine ecosystem**

Fueling th



By Margaret Nagle

CALANUS FINMARCHICUS are succulent little butterballs. Simply scrumptious to a whole host of marine animals.

No bigger than grains of rice, the translucent crustaceans that look like a cross between a crayfish and a flea gorge on spring phytoplankton blooms and microzooplankton in the ocean to bulk up with energy-rich lipids. It's those lipid reserves that make the planktonic copepods particularly delectable — and power-packed.

In the northern Atlantic Ocean, *C. finmarchicus* is the primary prey for a range of species — fueling schools of herring and powering pods of endangered northern right whales. This and other *Calanus* species are such vital intermediary links in the marine food web that changes in their populations could profoundly affect the health of marine animals — from leaner fish of lesser value to fewer whale calves — and the structure of the pelagic ecosystem in northern oceans.

That's why Andrew Pershing and Jeffrey Runge study them. The two research scientists, who hold joint appointments with the University of Maine and the Gulf of Maine Research Institute, consider *C. finmarchicus* a linchpin whose role must be better understood in the face of growing ecosystem variability and environmental change.

e ocean

It's midnight in Wilkinson Basin in the Gulf of Maine on the research vessel *Gulf Challenger* and University of Maine graduate student Cameron Thompson is up checking on the *Calanus Finmarchicus* collected for his research. Thompson, a dual-degree student in marine policy and biology, is studying the cross-shore mortality of the copepods in the Gulf of Maine.

Photo by Peter Stetson

Fueling the ocean

"Arguably copepods are the most abundant multicellular animals in the world, yet most people don't know much about them," says Runge, a biological oceanographer. "*Calanus finmarchicus* is among the most predominant of the copepods in the North Atlantic, including the Gulf of Maine. If its special capacity to produce large amounts of lipids were substantially reduced here, what would be the impact on species like herring, sand lance, mackerel and the rest of the system? It could have implications for the region's fisheries."

Runge studies ocean ecosystem productivity. He focuses on the physical and biological factors that can affect zooplankton production — from variable ocean currents and temperatures to the growth and survival of fish larvae.

Pershing focuses on what causes changes in the Gulf of Maine ecosystem over time. He uses satellite and other data to develop computer models of marine ecosystems that can reconstruct and forecast population dynamics in *C. finmarchicus* and other key species.

For both scientists, the implications of climate changes on *C. finmarchicus*, such as warmer water temperatures and acidification, loom large.

"There are huge changes going on in the marine environment," says Pershing. "Some of them are natural. We've always had changes in the climate. But then on top of that, we're adding this new signal of global warming and climate change. What effect that's going to have on ocean ecosystems is really important, both for understanding fisheries and the way humans interact with these systems, and for understanding the ocean's ability to take carbon out of the atmosphere and lock it away. The big question for me is really all about change: how things shift from one year to the next and what drives that."

"There are huge changes going on in the marine environment. Some of them are natural. We've always had changes in the climate. But then on top of that, we're adding this new signal of global warming and climate change." Andrew Pershing

C. FINMARCHICUS dominates the zooplankton community in the Gulf of Maine, the southern edge of the large copepod's subarctic range. Here, the one-eyed crustaceans that grow about 3 millimeters long spend their lives moving vertically in the water column, transporting carbon and valuable nutrients from the surface. As omnivores, they put a big dent in spring blooms, eating diatoms and phytoplankton, and preying on smaller zooplankton.

The spring phytoplankton blooms give the copepods tremendous reproductive capacity. Over a two-month period, a female will release 3,000 or more fertilized eggs into the water column, where they develop and hatch.

The copepod has a complex 12-stage life history, maturing from an egg to six nauplius and five copepodid stages to reach adulthood. During late summer through early winter, fifth-stage copepodids known as C5s constitute the majority of the *C. finmarchicus* population in the north Atlantic. At that time, the preadults either molt into adults or enter a state of reduced activity — a kind of dormancy or hibernation — known as diapause.

C5s in diapause have adapted to survive months with little food, at depths of around 150 meters in the gulf, with the help of the rich lipid stores they packed on in the spring and summer months. The lipids in the form of wax esters stored in an oil sac ultimately make up nearly 70 percent of the copepod's body weight.

Fish and whale species depend on that lipid source for their own survival. Herring predation, which is highest in the summer, is a big source of mortality for *C. finmarchicus*. Then there's the northern right whale, which eats at least 2,000 pounds of copepods daily. Of the nearly million calories a cetacean needs each day to function, the vast majority come from copepods.

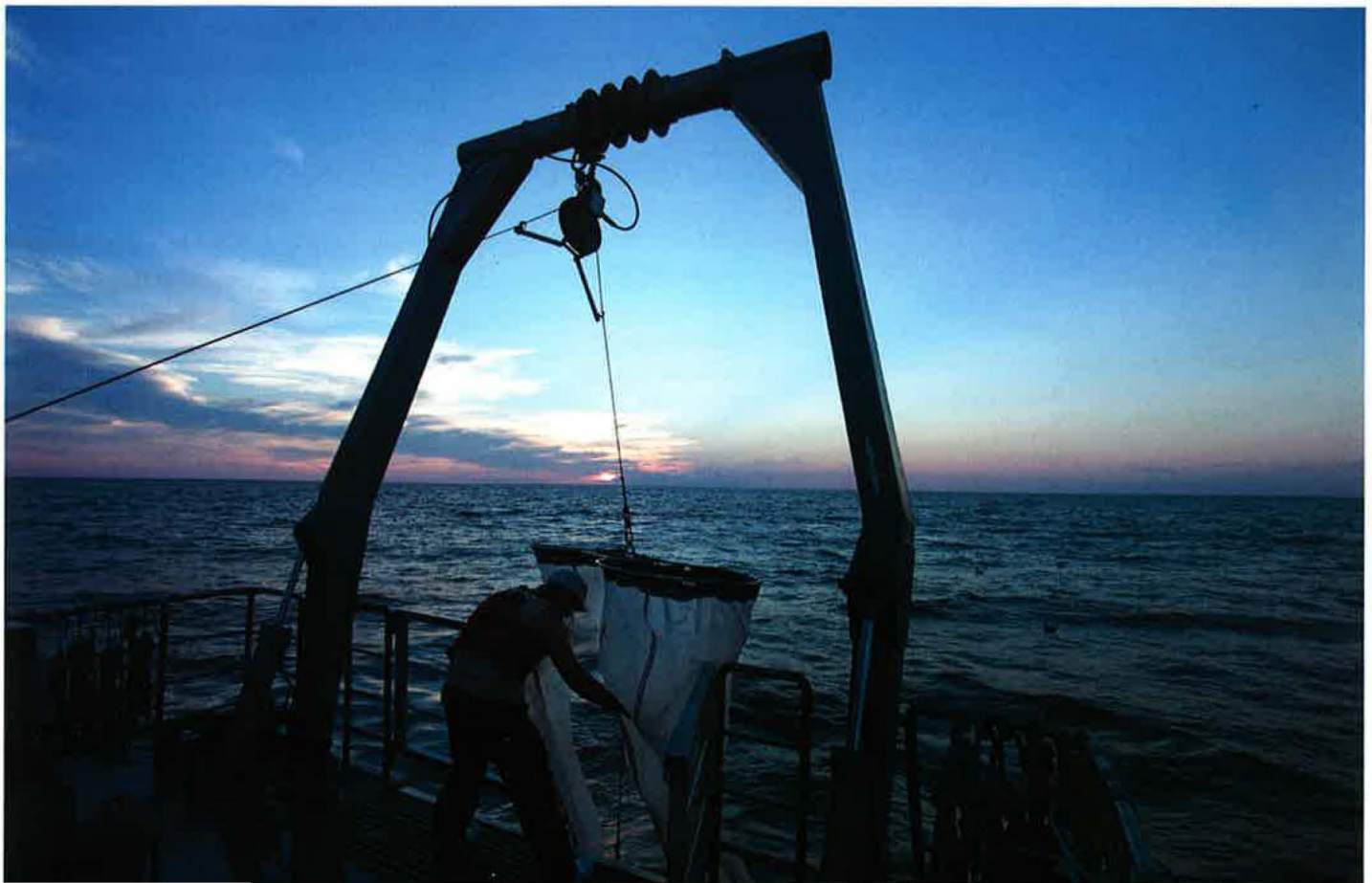
In the late winter and spring, C5s emerge from overwintering to molt into adults, feed and reproduce. The population increases rapidly, with a new generation of C5s appearing in mid-April. By early summer, some of those preadults will begin their own cycle of dormancy.

That's the typical seasonal production cycle.

But when the Gulf of Maine is too warm because of the intrusion of warmer Atlantic Slope water or above-normal surface temperatures, *C. finmarchicus* breaks its dormancy in late summer and fall and produces another generation, contributing to the overwintering stock. But these outside influences, what scientists

University of Maine graduate student Phoebe Jekielek washes copepods collected from a plankton tow into sample jars for preservation. The *C. finmarchicus* copepods are the size of grains of rice; the larger zooplankton also present (at far left) are krill. Specimens are collected in ring nets towed off the stern of the research vessel and kept alive in seawater in coolers for experiments back in the laboratory on shore.

Photos by Peter Stetson



Fueling the ocean

refer to as forcings, can not only accelerate but also hinder development of a fall generation if temperatures are too warm.

The concern is that climate change may result in substantial reduction in *Calanus* populations, according to a research team led by Runge that reported its findings most recently at the 5th International Zooplankton Production Symposium in Chile. What's needed are models that couple what we know about the copepods' life cycle and the physical circulation in the ocean to better understand the roles of transport and production. Also needed is a long-term, integrated observation system in American and Canadian waters focused on collecting data on zooplankton abundance and diversity in the north Atlantic.

"It's an important priority to have the capacity to observe how the system is changing," says Runge. "We have the pieces — the researchers and physical modelers — and can put together models that are very insightful, not just for understanding climate forcing on copepods, but also on the planktonic early life stages of marine fishes."

RUNGE'S RESEARCH examines the role of zooplankton in marine food webs, including the biological mechanisms behind diapause. He collaborates with Pershing and other oceanographers to create 3-D models integrating zooplankton production, larval fish survival and recruitment — the number of fish surviving the larval and juvenile phases to enter the adult population each year.

"The new tools, including computer modeling, are giving us tremendous capacity to address the questions we have (about copepods) and the potential to understand scenarios of climate change and how they will impact plankton populations," he says.

Runge and Pershing helped develop a life cycle model that examines the controls on diapause and can be used to investigate population responses to climate change scenarios for species of copepods. In collaboration with UMaine Postdoctoral Research Associate Frederic Maps and UMaine Research Associate Rebecca Jones, as well as researchers from NOAA, the University of Maryland and East Carolina University, they have studied the life histories of *Calanus* species and their response to climate forcing, looking in particular at the role of dormancy in both the north Atlantic and north Pacific.

Calanus finmarchicus Photo by Phoebe Jekielek

finmarchicus facts

C. finmarchicus copepods:

- ***dominate*** the zooplankton community in the ***Gulf of Maine***.
- are ***one-eyed crustaceans*** that grow about 3 millimeters long.
- devour the ***spring blooms*** in the Gulf of Maine.
- are ***omnivores***, eating diatoms and phytoplankton, and preying on smaller zooplankton.
- have tremendous reproduction capacity, with each female releasing ***3,000*** or more ***fertilized eggs*** into the water column.
- have a complex 12-stage life history that includes an ***overwintering dormancy*** called diapause.
- store up to nearly ***70 percent*** of their body weight in lipids.
- are delectable to a range of fish and cetaceans — from ***herring*** to endangered northern ***right whales***.

Most recently, Runge received a nearly $700,000, three-year National Science Foundation grant to study the impact of ocean acidification on three dominant species of high-latitude *Calanus*, including *C. finmarchicus* in the northern Atlantic. He and ocean chemist John Christensen will study the impact of increases of carbon dioxide, higher temperatures, and lower surface and deep pH on population dynamics on the copepods.

In the next century, ocean acidification and temperatures are predicted to rise. Previous studies have shown they could affect copepods' reproductive success and early-life stages.

Pershing is currently looking at how the number of copepods has changed in the last half-century. To do that, he uses data from the Continuous Plankton Recorder (CPR) Survey, a marine monitoring program of the National Marine Fisheries Service that has been collecting information on plankton since 1961.

Pershing is particularly interested in the monthly CPR data collected across the Gulf of Maine from Boston to Yarmouth, Nova Scotia. The continuous record offers an unparalleled perspective of year-to-year changes and patterns across four decades. In the case of *C. finmarchicus*, the CPR record has shown that the copepod was abundant in the gulf in the 1980s, but its numbers were low through the 1990s and took a nosedive around 1998, then rebounded.

Armed with that data, Pershing then looks for any changes in

the physical environment that may explain the sea change in the copepod population. He also studies the effect of those changes on other species in the food web that depend on copepods for sustenance. Those species include right whales.

"In particular," says Pershing, "we looked at the number of calves right whales produced and found that during the 1990s, when *Calanus* was low, right whales had fewer calves. They had more variable reproduction and were, actually, in poorer health. They tended to be skinnier. But in 2001, when *Calanus* rebounded, all of a sudden the right whale population was able to put out 20 or 30 calves per year and were in much better health."

The decline in large zooplankton, especially *C. finmarchicus*, also led to leaner herring that, in turn, led to bluefin tuna of lesser value.

Pershing is now looking at the role played by herring and other small pelagic fish in the Gulf of Maine, including the nutrients they supply to larger animals like tuna and whales, and their effect on zooplankton. The project was one of eight funded in 2010 by the Comparative Analysis of Marine Ecosystem Organization (CAMEO), a program of NOAA and NSF.

Pershing is joined on the research team by two scientists from UMaine, two from GMRI, three from NOAA, the one each from the University of Massachusetts and Ohio State University. The scientists are comparing the physical changes in the Gulf of Maine during three decades, beginning in the 1980s when herring stocks were low. The researchers hope to better understand the critical link between copepods and herring, and how trade-offs between fish abundance and fish weight are linked in fishery ecosystems.

How environmental conditions, including the degree of stratification and production of phytoplankton, determine species composition is now driving Pershing to develop a new class of copepod model. In 2003, he used an NSF Information Technology Research grant to develop a zooplankton model that is now the basis for forecasting *C. finmarchicus* distributions that are right whale feeding areas. His newest NSF-funded research is expected to help scientists make even better predictions concerning the effects of climate change on this critical trophic level.

"Once we have an estimate of what will happen to the copepods, I think we can have a much better estimate of how fisheries in a particular region will respond, as well as the birds, whales and other animals people really care about," Pershing says. ■ Online

Copepods and cetaceans

ANDREW PERSHING'S pioneering work in marine ecosystem modeling improves our understanding of how the dynamics of the ocean environment influence fish and mammal populations over time. His modeling includes forecasts of where right whales are likely to be in the Gulf of Maine in an effort to allow ships to plan their routes accordingly, whether avoiding the area or slowing their speeds.

"Our research is really trying to find ways to predict where and when whales are likely to be there," he says. "We know the whales are here in the Gulf of Maine to feed, so if we knew where lots of copepods would be, that would be an area you would expect whales would hang out."

It is estimated that fewer than 400 right whales remain in the north Atlantic and all of them feed in the Gulf of Maine, says Pershing. The slow-moving, surface-feeding mammals particularly prized for their blubber, thus earning them the moniker of the "right" whales, were hunted to near extinction in the early 20th century.

Today, the endangered species is threatened most by ship strikes and fishing gear entanglements. Keeping them strong is *Calanus finmarchicus*, a copepod that constitutes more than 90 percent of the calories consumed by right whales.

But it isn't easy counting copepods collected using plankton nets dragged behind research vessels. That's why Pershing and his research team turned to satellites for information on ocean temperature and the amount of chlorophyll in the water from phytoplankton blooms. A lot of chlorophyll means that female copepods will produce a lot of eggs. If the water is warm, the eggs could mature into adults in half the time — three weeks instead of six weeks.

In Massachusetts Bay, the traditional feeding ground for right whales in the first three months of the year, researchers at the Provincetown Center for Coastal Studies collect zooplankton information weekly. Their copepod data and whale observations have further informed the models of the UMaine scientists. The result is a better set of predictions with the potential to inform ship traffic.

"It suggests that this technology is there, that with the right samplings scheme and with the right modeling, we could probably say when there will be a high probability of whales in a shipping lane — a time when you would want to be extra careful," says Pershing.

Figuring out the best way to use such information in resource management is a challenge, Pershing admits. It could range from an overarching seasonal reminder to strategic enforcing of speed limits for vessels approaching Boston Harbor when right whales are predicted to be particularly prevalent.

Photo by Daniel Pendleton

Going VIRAL

For students in Carol Kim's lab, enthusiasm for research is infectious

By Kristen Andresen

THE QUESTIONS come in rapid succession, like machine-gun fire, sharp, fast, relentless:

"You can see the bacteria?"

"Do you want to say the quality value of biofilm formation?"

"Why would isolating them give you a different value?"

"Are there any other explanations?"

"How do you have 1.8 fish?"

Things can get pretty intense in the hallway outside Carol Kim's microbiology lab in Hitchner Hall at the University of Maine. For the casual observer — especially one without a science background — the barrage of questions is overwhelming, like listening to an auctioneer calling in a foreign language. But the three undergraduates standing there explaining their senior research projects, pointing to printouts of data and microscopic images of zebrafish taped to the walls, are completely unfazed. They answer Kim's questions almost as quickly as she asks them. When she challenges them, they challenge back. They are confident. Eloquent. They know their stuff.

> **"I love doing the brainstorming, working with a student to figure out the best question to ask."**
>
> Carol Kim

Which is exactly the way Kim, a professor of biochemistry, microbiology and molecular biology who directs UMaine's Graduate School of Biomedical Sciences, likes it.

She wants to maintain rigorous and demanding standards, without the fear that can sometimes overwhelm students during their training in the sciences.

Professor Carol Kim, center, discusses details of a groundbreaking virus study in zebrafish with students Kristin Gabor, left, and Bradie Manion.

Going viral

"I want to set up an environment where students feel comfortable and nurtured," Kim says. "They have to know I'm going to ask tough questions and they have to be prepared. It's going to be a lot nicer for me to ask them than to have them present in front of five professors cold. If I can be tough on them and they can answer the questions, they'll have confidence."

Kim is emblematic of a major push on campus to involve undergrads in research, and scenes like the one outside her lab play out across campus daily, especially in the weeks leading up to graduation. At UMaine, hundreds of science, humanities and engineering majors are involved in research, and close collaborations with faculty are common.

Increasingly, UMaine has become a destination for top students interested in pre-med and biomedical studies, in large part because of the mentoring and rigorous preparation that Kim and her colleagues provide. As a result, many undergraduates are working at a graduate level long before they earn their bachelor's degree. Like the students in the hall, they know the answers. But more important, they know which questions to ask.

KIM'S RESEARCH has moved the entire field of virology forward. She conducts disease studies with zebrafish, a model organism, to better understand the human innate immune response to infection. She's the driving force behind UMaine's Zebrafish Facility, and since she arrived at UMaine in 1998, Kim has received continuous funding for her zebrafish research — more than $4 million in federal grants, primarily from the National Institutes of Health. Among her landmark discoveries is a zebrafish gene that produces interferon, which can inhibit the growth of a virus. She and colleague Rob Wheeler recently received a $60,000 NASA planning grant to study the effects of radiation on innate immune response and the progression of cancer.

Her work provides a better understanding of how bacteria infect and cause inflammation in cystic fibrosis patients. Kim's studies shed light on the connection between the cystic fibrosis transmembrane conductance regulator, or CFTR, and the innate immune response. That connection may someday be used as the basis for therapeutics that combat bacterial infections in cystic fibrosis.

"Clinical researchers are trying to develop therapeutics for the immediate needs of these patients, and as a result, we've seen significant increases in their quality of life. We're on the other end, with basic research, trying to figure out

Zebrafish research at UMaine

The zebrafish is an ideal model organism to study genetics, pathogen-cell interactions and more. The following are among the faculty researchers tapped in to UMaine's Zebrafish Facility:

Sharon Ashworth: Dynamic interaction of actin and actin-associated proteins as related to acute renal failure.
Dorothy Croall: Characterizing calcium-dependent enzymes as they relate to cell biology and physiology.
Julie Gosse: Environmental toxicants and the allergy response.
Clarissa Henry: Genetic, genomic and cell biological analysis of muscle development.
Keith Hutchison: Understanding control of the earliest moments of development.
Carol Kim: Characterizing the effects of infectious diseases and environmental toxicants on the innate immune response; cystic fibrosis research.
Rebecca Van Beneden: Examining the effects of environmental toxicants on host physiology and cancer development.
Rob Wheeler: Host immune response to fungal pathogens.

Photo at right: Undergraduates Aaron Perreault and Bradie Manion in UMaine's Zebrafish Facility. They are two of five UMaine students admitted as sophomores to Tufts University School of Medicine through the Tufts Maine Track Early Assurance Program since 2009.

what's happening at the molecular and cellular level with the hope of developing those therapies. This project will be ongoing until CF is completely cured, until it's no longer a problem. It's going to take a while."

ANOTHER RECENT collaboration with UMaine physicist Sam Hess and graduate student Kristin Gabor focuses on immune response to viral infection — not necessarily in CF patients. By using super-resolution microscopy, the researchers are the first ever to view the single-molecule cellular interactions involving antiviral signaling in caveolae, which are flask-like invaginations in the cell membrane.

While previous research has shown that viruses exploit caveolae to enter host cells, Kim took it a step further by demonstrating that viruses can evade host cell defenses by disrupting clusters of signaling molecules within the caveolae. Through a combination of fluorescent tagging and super-resolution imaging of viruses and zebrafish cells, Hess' FPALM (Fluorescence Photoactivation Localization Microscopy) system has allowed Kim and her team to see how individual molecules and clusters move during a viral infection.

"No one has ever really looked at this," Kim says. "No one's been able to see it the way we've been able to see it."

To the uninitiated, these may seem like disparate projects, but they all have two things in common: zebrafish and the innate immune response, the body's first line of defense against infection. Innate immunity deals with how the body reacts immediately after it comes in contact with a pathogen. This happens daily, almost constantly, and it's why healthy people don't get sick every time they encounter a new pathogen. It's why your skin swells when you get a splinter or a paper cut. This is not to be confused with adaptive immunity, which is acquired through vaccination or prior infection.

Zebrafish are the ideal model for this research for several reasons, including the fact that they develop rapidly and their embryos are clear, allowing researchers to see infection as it happens.

Carol Kim is emblematic of a major push on campus to involve undergrads in research. At UMaine, hundreds of science, humanities and engineering majors are involved in research and close collaborations with faculty.

Innate immunity is pivotal to learning how the body defends itself against infection, how viruses and bacteria adapt to the body's defenses, and how more effective treatments might be developed.

Even one of these accomplishments would be noteworthy. Together, they're huge. But when asked if there is a single moment that has defined her time at UMaine, Kim doesn't miss a beat.

"Every year, when students in our department get into the top graduate schools, the top medical schools, the top dental schools, when they get great jobs it makes me think, 'Wow, that's why we're here.' UMaine is only the first step, but we hope we had an impact on their lives."

KIM WILL DO whatever it takes to instill confidence in her students. Sometimes that means an informal hallway inquisition. Other times, it means meeting on nights or weekends to make sure that her students are prepared to consider every angle when defending their theses or dissertations. And sometimes, it just means handing over the reins.

When Steve Altman was at UMaine — he earned a bachelor's in microbiology in 2002 and a master's in molecular biology in 2003 — he worked on basic immunology in zebrafish. Kim gave him a lot of wiggle room with his experiments, but she also challenged him to try things that might be outside his comfort level, and that continues to influence the way he does science.

"Some of my friends worked in labs where the principal investigator told them what to do," recalls Altman, who now conducts Alzheimer's research for Amgen in Cambridge, Mass. "With Carol, it was a little bit more open-ended. She gave me guidance, but she also allowed me to make decisions on my own. That stuck with me."

Inspiring the next generation of doctors and researchers is what gets Kim out of bed in the morning. She wants them to get jazzed about how crafty bacteria and viruses are.

"I love doing the brainstorming, working with a student to figure out the best question to ask," Kim says. ■

Research economics

A decade of exceptional growth reflects growing state and societal expectations

Is it possible that those who are on hand ... in 2013 will find multimillion-dollar research laboratories adjacent to pulp and paper schools, where basic investigation, as well as the search for new products and new processes, is a major function? Whether the examples of the Massachusetts Institute of Technology and Stanford in their association with electronics and other space-related industries is a pattern for others to follow, or whether these experiences are unique, will probably be answered in the next 50 years.

University of Maine President Lloyd H. Elliott, speaking to the Newcomen Society on "Unique Partners in Progress, the University of Maine and the Pulp and Paper Industry," Boston, 1964

JAKE WARD THINKS that former University of Maine President Lloyd Elliott would be pretty impressed with the University of Maine in 2011.

As UMaine's assistant vice president for research, economic development and government relations, Ward has seen the university's research and development enterprise evolve — especially in the past decade — to the point where the fulfillment of Elliott's prediction represents only a small part of a thriving, comprehensive research enterprise.

"It's easy to quantify the growth in research and development just by looking at research grants and expenditures," he says. "But the change in culture has been equally important. Our researchers really understand and embrace the responsibility of helping grow Maine's economy through R&D."

In 1997, the Maine legislature and Gov. Angus King created the Maine Economic Improvement Fund (MEIF), designed to boost Maine's economy in seven targeted technology sectors through university-based research. Triggered by the grassroots efforts of five UMaine professors — the rightful heirs to Lloyd Elliott's legacy, if you will — MEIF has been the true catalyst for the dramatic progress of the past decade.

Those funds, often used to match federal grants, have allowed UMaine researchers such as Habib Dagher (AEWC Advanced Structures & Composites Center), Hemant Pendse (Forest Bioproducts Research Institute), Robert Lad (Laboratory for Surface Science and Technology) and others to move their programs to a higher plane. It also has led to what Ward calls a "new wave" of researchers, for whom the link between the laboratory and the economy has always been at the forefront of their thinking.

"The university has changed at the same time the state has changed," says Ward, a Saco native who has been at UMaine since 1990. "The research community embraces its responsibility to help improve Maine's economy and we understand that we can have our greatest success by engaging statewide partners in academic institutions, public and private research institutions, and industry.

"Our combined resources, especially in fields like the biosciences, are significant enough that we can bring in grants and develop the ideas that will create economic opportunity in research, create businesses and create jobs."

The research and development landscape continues to shift, Ward says, ratcheting up the expectations.

"We were like newborns (in research) in 1998, then we were toddlers and adolescents for a few years," he says. "Now we're becoming young adults. We're

$100 million
A YEAR IN GRANTS AND CONTRACTS ACHIEVED FOR THE FIRST TIME IN UMAINE HISTORY IN FY10

80%
of MEIF funding to the University of Maine System is allotted to UMaine

2.4 times
more federal research dollars in FY10 than in FY00

7 STRATEGIC RESEARCH AREAS are funded by MEIF — aquaculture and marine sciences, biotechnology, composites and advanced materials technologies, environmental/energy technologies, information technologies, advanced technologies for forestry and agriculture, and precision manufacturing

$11 MILLION BOND *in 2010 to create jobs through investment in offshore wind energy research and development* **WILL LEVERAGE $24.5 MILLION** *in federal funds.*

82 PATENTS FILED BY UMAINE FY05–FY10

$273 million
in total sponsored research funding from FY05-FY10

623 research proposals submitted for external funding in FY10

70% of research proposals were funded in FY10, second only to 74% funded in FY07

$107.5 million
IN MAINE ECONOMIC IMPROVEMENT FUND MONIES SINCE 1998

6 R&D bond issues approved by Maine voters since 2000

5 UMaine research projects funded in the third round of the Maine Technology Asset Fund competition in 2010 for a total of $3.54 million

2,182
faculty, research staff, and professional and classified employees involved in externally funded research in FY09

$79,231,884
in federally funded research in FY10 — the highest amount ever received at UMaine

$4.9 million

UMaine's largest Maine Technology Asset Fund award, funding advanced nanocomposites for the renewable energy industry

For every $1 the state invests in UMaine through MEIF, researchers leverage approximately $5 from sources outside Maine

250 percent growth in UMaine's overall external grants and contracts, and a patent portfolio and spin-off business increase by a factor of 10 since the start of MEIF funding in 1997

energetic and we've shown that we can deliver. The challenge now is to find ways to continue to grow, in the face of economic challenges, and lead the initiatives that will expand Maine's economy in sustainable ways."

Those challenges are significant, he says. Research programs need capital to grow and foster economic development while providing more and better educational opportunities. UMaine's research programs are attracting good students and that's a positive sign of meaningful growth.

The challenges are also significant for many of Maine's core businesses, the small and medium companies, especially in traditional industries in the rural areas of Maine, Ward says. In fact, these types of companies may be well positioned to take advantage of an economic turnaround if they can bring innovative products and services to the market in time.

Ward points to UMaine's new Innovation Engineering Program — which a student in any major can attach to his or her curriculum as a way to foster entrepreneurial education — as a key component that can differentiate the UMaine academic experience from others while providing innovative employees Maine employers need to grow and succeed.

A recent National Governors Association Center for Best Practices report challenges states to align higher education curriculum with the needs of the marketplace to foster economic development. The report points to Minnesota, North Carolina, Ohio and Washington as states that have already undertaken comprehensive strategies to create those connections.

A key component of a successful strategy, according to the report, is an effort to encourage employers' input in higher education. The University of Maine System, in partnership with the Maine Development Foundation and the Maine State Chamber, has recently taken that step by creating two reports: "Making Maine Work: The Role of the Public University System."

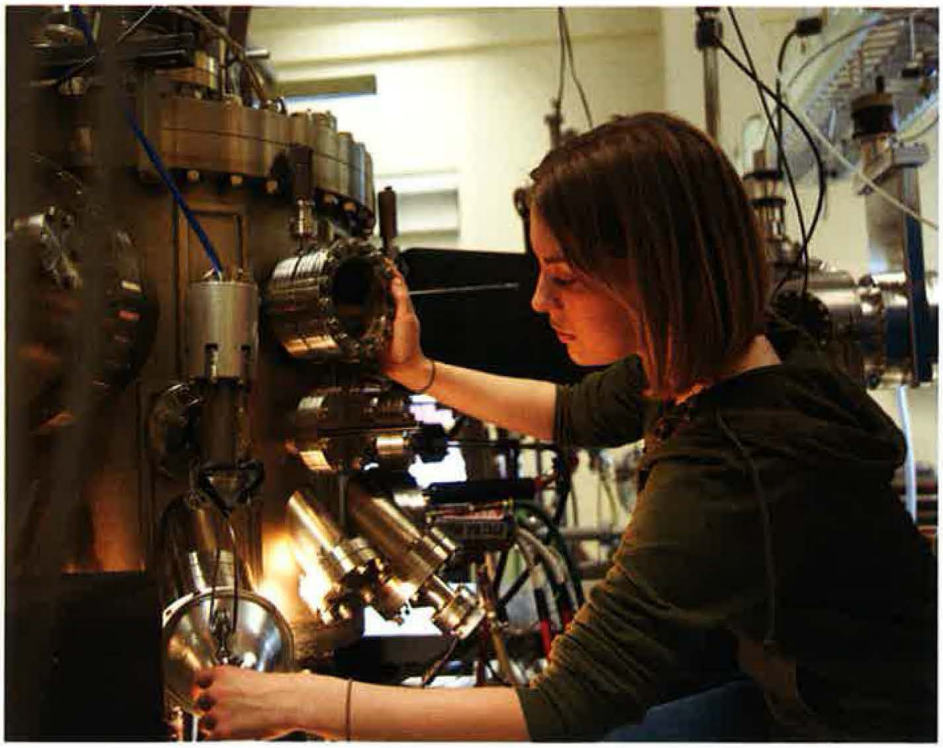
"In a state like Maine, there are high expectations placed on the primary research university because there is only one," Ward says. "We need to embrace that responsibility and hold ourselves to a high level of accountability. The changes we are experiencing can also create more and better educational opportunities in disciplines across the university as we educate our students for leadership roles in our statewide community. It's more than workforce development; it's using education, research and development to shape Maine's economy and its culture."

As Maine and UMaine evolve within the changing global economy, the university is on pace to continue and expand its impact, Ward says. He sees a university that is starting to look like the one Lloyd Elliott described in 1964. Building on the progress of the last decade, especially by taking advantage of the opportunities of public-private partnerships, he envisions UMaine as the key driver of Maine's future economy.

"There's an emerging and growing recognition of Maine's land-grant university as a key component of the state's future," Ward says. "With that recognition comes expectations, but we have the pieces in place, along with the institutional commitment, to live up to those responsibilities." ■

Sensing research

The undergraduate experience at LASST



Bryn Nugent from Rockport, Maine, graduated from the University of Maine in May with a degree in engineering physics and will pursue a Ph.D. in physics at UMaine.

In the lab: My research in the Laboratory for Surface Science and Technology (LASST) involves the surface characterization of langasite (LGS) crystal wafers in high-temperature environments. LGS is used in surface acoustic wave sensor devices that operate at high temperatures (more than 800 degrees Celsius). Because these sensors are extremely surface-sensitive, it's important that we know exactly how the crystal surface changes when heated. Knowing this will give us more insight into long-term crystal stability at these temperatures, thus ensuring the longevity of the sensor platform.

In the real world: The real-world applications include high-temperature monitoring of turbine engine components during operation. Hopefully, the feedback from the surface acoustic wave sensors will help better predict engine component failure and give a more accurate picture of the wear occurring in these engines. It has the potential to save lots of money and increase the safety of turbine engines.

A summer of sensors: I became involved in this research through the National Science Foundation Research Experience for Undergraduates Sensors summer program at LASST in 2009 and 2010. I began my research during the summer project and continued it through the school year. The program is an excellent way to be more involved in in-depth research and it really helped me decide what I wanted to do after graduation. I look back at my participation in the REUs as one of the most important things I did.

LASST word: It has been really wonderful. I worked in cutting-edge facilities with some of the most experienced and talented professional researchers in the country. It was a lot of work, but I find the research I am doing to be extremely rewarding and I learned a lot.

Going the Distance

EACH YEAR, female Blanding's turtles travel more than half a mile from their wetland homes to their favorite upland nesting sites. But that's a problem in areas like York County in southern Maine, where development has not only altered the habitat, but also increased the danger of road mortality. To better understand the upland movements of Blanding's and another at-risk species, the spotted turtle, wildlife ecology researchers at the University of Maine and the Maine Department of Inland Fisheries and Wildlife radio-tracked 46 nesting females between April and November over a three-year period. The data will help determine the extent to which the female turtles would use artificial nest sites to modify or reduce their upland treks, decreasing the risks of road mortality and predation that threaten the viability of the species. Among the research team's findings, reported in the journal *Herpetological Conservation and Biology:*

3,300 the average number of feet traveled by female Blanding's turtles as they move from wetlands to upland nesting sites, which is more than six times the distance covered by spotted turtles.

84 the percent of Blanding's turtle nests found in human-altered sites, such as pastures, roadsides and backyards.

2 the number of weeks of the longest upland foray during the nesting season of the female Blanding's turtle, which included nondirect, meandering movements.

Blanding's turtle Photo by Ann Brokelman

Lobster golf balls a hit

GOLFERS ON THE HIGH SEAS can breathe a little easier — and so can the marine life around them — thanks to researchers at the University of Maine.

In collaboration with the Lobster Institute at the University of Maine, Biological and Chemical Engineering Professor David Neivandt and undergraduate student Alex Caddell of Winterport, Maine, have developed a prototype of a biodegradable golf ball made from lobster shells. The ball is intended for use on cruise ships.

Carin Poeschel Orr, who earned a master's in marine bioresources at UMaine in 2002, suggested the idea to Lobster Institute Director Bob Bayer. Bayer turned to Neivandt, who is known on campus as an innovative problem-solver.

Though biodegradable golf balls already exist, this is the first to be made with crushed lobster shells with a biodegradable binder and coating, creating value from waste material.

"We're using a by-product of the lobster canning industry which is currently miserably underutilized — it ends up in a landfill," Neivandt says. "We're employing it in a value-added consumer product, which hopefully has some cachet in the market."

> **"We're using a by-product of the lobster canning industry which is currently miserably underutilized — it ends up in a landfill. We're employing it in a value-added consumer product, which hopefully will have some cachet in the market."** David Neivandt

And that cachet doesn't come with a higher price tag. Biodegradable golf balls that are now on the market retail for a little under $1 per ball. The raw materials for the lobster shell balls cost as little as 19 cents per ball.

Caddell, a golfer, says the balls perform similarly to their traditional, white-dimpled counterparts. And they can be used with both drivers and irons.

"The flight properties are amazing," Caddell says. "It doesn't fly quite as far as a regular golf ball, but we're actually getting a similar distance to other biodegradable golf balls."

UMaine has filed a provisional patent for the lobster-shell mixture, which can also be used for such products as plant pots that decompose in the ground, surveying stakes and other applications.

For Caddell, a junior biological engineering major and honors student, the opportunity to do research that has a real-world application has been a highlight of his UMaine experience.

"I didn't really think it would turn out to be this fruitful," Caddell says. "What really makes UMaine great is that there is a lot of funding available here, as opposed to private schools where it's hard to get research opportunities. Here, all sorts of professors are willing to take on students."

News of the innovative golf balls has made headlines worldwide, attracting attention from as far afield as New Zealand and Pakistan, and UMaine's Department of Industrial Cooperation has fielded many queries from private firms interested in commercializing the product.

Aging with nature

GROWING OLD in the country has its disadvantages. There's less access to shopping and healthcare, and fewer employment opportunities. Even traveling distances to a neighbor's house can be difficult. However, two social science researchers have found rural elders have one advantage over their urban counterparts: nature.

University of Maine Professor of Social Work Sandra Butler conducted interviews with elders living in rural Maine and found that nature's beauty, peace, safety and open space are treasured aspects of their lives. Those surveyed said they value nature and the ability to interact with it through activities such as gardening, walking and bird watching.

A smaller study in Vermont, conducted by licensed social worker Adrienne Cohen, also found that nature or "aesthetic capital" contributed to the well-being of elders. For them, just seeing nature outside their window at home or in a car was important.

The researchers' findings, reported in a recent issue of *Nature and Culture*, underscore the fact that proximity to nature contributes to quality of life.

Paying for food safety

AT THE FEDERAL LEVEL, it's easy to quantify the cost of foodborne illness as measured in terms of death and illness. But it's a lot harder to quantify benefits of stronger food safety regulations.

That's where UMaine economist Mario Teisl comes in.

In an article recently published in the journal *Food Policy*, Teisl and Brian Roe of Ohio State University propose an alternative to the traditional cost-of-illness approach. The cost-of-illness approach is straightforward — it measures such tangible values as lost work time, cost of medical treatment and loss of life. But it doesn't take into account things that are a little harder to gauge, such as pain, suffering, worry or loss of leisure time. This means that current regulation methods may undervalue the benefits of stronger food safety measures.

Through a national survey that centered on hot dog and hamburger consumption, Teisl and Roe found that consumers would be willing to pay more for safety-enhanced products — especially if the increased cost was relatively low and the decrease in probability of illness and contamination high.

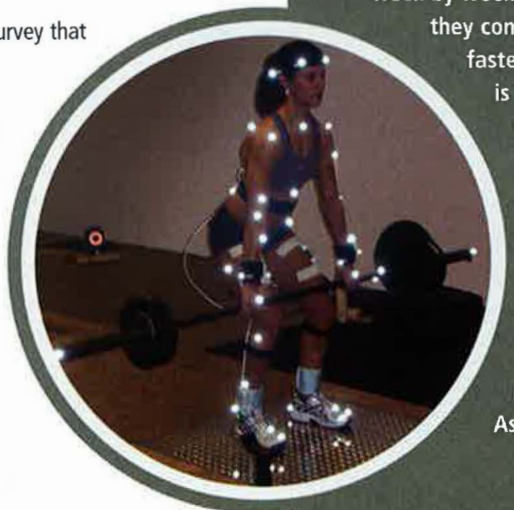
Improving performance

A UNIVERSITY OF MAINE track and field coach has teamed up with exercise science and mechanical engineering researchers to improve the performance of his athletes.

The researchers are studying the movement and force-generation patterns of the athletes during their block starts on the track and in various weight-training exercises. These include a high-speed motion capture system to record whole body movements, electromyograph (EMG) sensors to measure real-time neuromuscular activity, in-shoe sensors that pinpoint pressures on the sole of the foot and an inground force plate that helps calculate the athletes' power.

Study results are expected to have a profound impact on the training techniques employed by track athletes, sprinters in particular, the researchers say. Preliminary findings have better informed assistant UMaine track coach David Cusano about which muscle groups need to be the focus of offtrack strength and power training sessions. He has modified his weight room program so it specifically supports the athletes' explosiveness on the track, helping to shave precious hundredths of a second off their times.

According to exercise science graduate student Thomas Ordelt, 70 percent of the sprinters participating in the research are consistently improving their personal bests in the weight room week by week, but more importantly, they continue to run faster and faster on the track. Ordelt is conducting the research as part of his master's thesis under the supervision of two UMaine faculty members — exercise physiologist Robert Lehnhard and mechanical engineer Ashish Deshpande.



Rethinking catch and release

REQUIRING ANGLERS to catch and release wild brook trout is one way to help conserve the native species that is in decline. But a new study shows that the resource management strategy also has a downside: hooking mortality rates with the potential to significantly reduce the number of trophy fish, according to two University of Maine wildlife ecology researchers.

In their modeling study, graduate student Casey Risley and Joseph Zydlewski, an assistant professor in the Department of Wildlife Ecology and a member of the U.S. Geological Survey Maine Cooperative Fish and Wildlife Research Unit, found that even modest increases in hooking mortality rates associated with catch and release fishing were enough to strongly shift the age structure of a brook trout population to one dominated by young stock. The higher the angling pressure — the more the waters are fished — the bigger the decline in density of older or larger fish.

Hooking mortality is generally higher for fish caught on bait and artificial lures than on flies. It also is extrapolated by such factors as the lengths of time the fish are played in the water and held out of the water. The research findings, published in the *North American Journal of Fisheries Management,* demonstrate that such fisheries may be sustainable only at low intensities of angling.

Life on the fringes

USING GENETIC TESTING to identify which microbial communities are present in groundwater — and which are not because of their sensitivity to low levels of contamination — could improve water quality monitoring near leaching municipal landfills, says a University of Maine environmental engineer.

UMaine assistant research professor Paula Mouser profiles microbial communities found in the groundwater using a strand of their rRNA. The bacteria and archaea communities have particular sensitivity to landfill leachate, and shift in response to the introduction of nutrients or contaminants. Some bacteria disappear, while others increase in abundance near the leading edges, or fringes of the plume.

Such biological analysis offers increased detection sensitivity over conventional hydrochemical testing in wells, which could improve long-term water quality monitoring efforts near leaking solid waste disposal sites. Just as important, early detection could prevent widespread contamination or increase remediation efficiency.

While at the University of Vermont, Mouser led a research team that profiled microbial communities in monitoring wells at the 30-acre Schuyler Falls Sanitary Landfill in Clinton County, N.Y. Their findings were published in the journal *Water Resources Research* and featured in the *New York Times.*

Responding to bullies

WHEN SUPPORTING a friend who has been victimized by a bully, young adolescents respond with a range of advice and actions. Girls most often suggest telling an adult or confronting the bully to try to understand the conflict, while boys are more apt to minimize the seriousness of the incident or, to the other extreme, encourage aggression toward the assailant, according to a psychological study at the University of Maine.

Understanding young adolescents' responses to the bullying of peers and what those responses say about the quality of children's friendships is the first step in determining how best to help victims, according to UMaine Doctoral Research Fellow Amy Kaye, a fifth-year student in the Psychology Department's Clinical Ph.D. Program. The most effective peer responses, including the differences between what boys and girls say and do to victimized friends, could inform intervention efforts.

The UMaine study is one of the first to examine whether the way in which middle school students respond to support-seeking friends is associated with positive and negative peer experiences, including friendship quality, conflict in friendship and victimization.

All for one

AS A FORMER hockey player, Niclas Erhardt knows the importance of teamwork. But the concept is equally important in his current role as an assistant professor of management in the Maine Business School. The journal *Management Learning* recently published, "Is It All About Teamwork? Understanding Processes in Team-Based Knowledge Work." According to Erhardt, teamwork is best when:

- the task is complex
- team leaders understand the type of know-how necessary to address the problem
- there's open communication and people are kept in the loop
- status differences are checked at the door, since titles are barriers for effective knowledge integration
- participants are able to physically get together to hash out complex questions

The fiercely competitive are less forgiving

FORGIVE AND FORGET? Well, that all depends on how competitive you are. University of Maine researchers Shawn Collier, Richard Ryckman and Joel Gold, along with University of Southern Maine researcher Bill Thornton, conducted a survey to determine what effect competitive attitudes have on forgiveness. Their findings, published in the *Journal of Psychology,* show that hypercompetitive individuals — those who are individualistic, who see their competitors as enemies, and who are willing to win at all costs — aren't likely to forgive transgressions. However, people whose competitive nature focuses on personal development — who are motivated to win by a desire to improve themselves, and who see their competitors as worthy opponents — are more likely to forgive. Ryckman's previous studies also showed that they're more psychologically healthy, altruistic and caring.

Mussels to fight sea lice

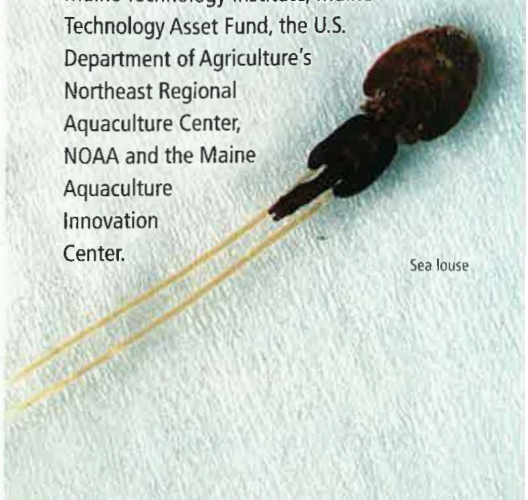
RAISING BLUE MUSSELS with farmed finfish may help reduce the infection of sea lice that decimates salmon and other species, according to University of Maine aquaculture and microbiology researchers.

Initial research findings demonstrate that blue mussels eat the larvae of the parasitic pest that has recently made a comeback on Maine fish farms. If further analysis in the field holds up, the use of mussels on salmon farms could be another disease management strategy for reducing the infectious pressure of sea lice in the farmed fish industry.

The research also has implications for the development of integrated multitrophic aquaculture, an alternative to the standard monoculture aquaculture with the potential to reduce environmental impacts by combining the farming of fish with filter-feeding shellfish.

Postdoctoral researcher Sally Molloy, a microbiologist in UMaine's School of Marine Sciences, made the discovery last summer along with graduate student Michael Pietrak and colleagues in Fisheries and Oceans Canada (DFO). Ian Bricknell, the Libra Professor of Aquaculture Biology and director of UMaine's Aquaculture Research Institute, and Debbie Bouchard, manager of the Maine Aquatic Animal Health Laboratory at UMaine, provided research support.

Their findings have been published in the journal *Aquaculture.* The research was funded by nearly $1.6 million in grants from groups that include Maine Sea Grant, the Maine Technology Institute, Maine Technology Asset Fund, the U.S. Department of Agriculture's Northeast Regional Aquaculture Center, NOAA and the Maine Aquaculture Innovation Center.



Sea louse

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Sharing spirit

The Maine Spirit Fund was established at the **University of Maine Foundation** in 2007 to provide stable, long-term financial support for student groups at the University of Maine. As the university's goodwill ambassadors, student organizations bring entertainment and spirit to events on campus, throughout the state and beyond. Income from this fund supports those student groups and organizations in such endeavors. Investing in today's students is an investment in the future. They deserve our support.

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